Aluminium suppliers :
S. A. Sidal à Duffel.
S. A. pour l'Industrie de l'Aluminium à Zurich.

Plexiglass windows :
Etabl. Jacques Obra & Cie à Liège.

Lift :
Ascenseurs Schlieren à Zurich.

Escalators :
Ateliers Jaspar à Liège.

Metal stairs :
Ateliers de Perforation Jaspar à Liège.

Metal floors :
« UTIL » à Bruxelles.
S. A. des Laminoirs de Longtain à La Croyère (Bois-d'Haine).

Main electrical installation :
S. A. S. E. M. à Bruxelles.

Exterior lighting :
Constructions électriques Schréder à Ans-lez-Liège.
L'Electro-Navale & Industrielle à Anvers.

Inside lighting :
C. E. T. E. L. à Bruxelles.
Ets Tant.

Air conditioning :
Ateliers B. Lebrun à Nimy-lez-Mons.
Usines Wanson à Haren.
Frigibel à Anvers.

Telephone installation :
Bell Telephone Mfg Cy à Anvers.

Paint work :
S. A. J. G. De Coninck & Fils à Bruxelles.
Usines G. Levis à Vilvorde.
Sté belge de Couleurs & Vernis à Bruxelles.

Restaurant decoration :
Etabl. Jasinski à Bruxelles.

Roofing of reception pavilion :
Sté industrielle du Plastique armé à Blegny-Trembleur (Liège).

Water piping :
S. A. Van Saet-Lenaerts à Bruxelles.

Metal trimmings :
Ateliers de construction métallique de et à Genval.

ATOMIUM 58

The ATOMIUM

Designed and built for the Brussels Universal and International Exhibition 1958 by the Belgian Metal Industries :

- Federation of the Metalworking Industries, " FABRIMETAL ".
- Belgian Blast-Furnace and Steelworks Group.
- Union of Non-Ferrous Metals Industries.

FOREWORD

By Mr. F. LEBLANC
President of the "Atomium" Association

In Autumn 1954, Baron Moens de Fernig, High Commissioner of the Brussels Universal and International Fair 1958, asked the Belgian blast-furnace and steel manufacturers Group to examine with Fabrimetal the possibility of erecting a spectacular structure on the World Fair site ; this structure was meant to be a symbol for this international event, and be the consecration of the possibilities of the Belgian industry.

It was then that Mr. André Waterkeyn, an engineer, Director of Fabrimetal, came to me with his conception of a structure evoking the possibilities opened up to mankind by the harnessing of the tremendous energy potential contained in the nuclei of atoms.

The solution he visualised was to materialise the notion of the atom by a very large metal construction. A metal crystal of the centered cubic system was a natural enough choice for the metal industries that were to erect the desired structure.

Such a conception seemed very fitting and attractive to me and I asked Mr. Waterkeyn to continue with the project studies.

The project was submitted to the leaders of the three Metal Industry Groups, all of which accepted, with the conviction of having found the obvious solution to the problem which had confronted them.

The projected structure was named Atomium by its creator because of the atom it symbolised and because from the beginning the project was intended to house

within the available space in the spheres exhibits illustrating the peaceful uses of atomic energy.

The three industrial groups, Siderurgy, Fabrimetal and Non Ferrous Metals, between them created a non-profit making Association, with Messrs. André Waterkeyn, Director of the Economic Department of Fabrimetal, and Em. Greiner, Director of the "Centre belgo-luxembourgeois d'Information de l'Acier" as managing directors. The team was completed by Messrs. Beckers, Joukoff and Daniel, Consulting Engineers, Messrs. A. & J. Polak, architects, and Mr. Hébrant, Director of the Commission for the design of metal constructions.

The help of many specialists was sought and, although their number makes it impossible to name them all, it is a pleasure for me to thank them for their enthusiastic collaboration.

Preliminary design began. The problems to be solved were many and varied, and the time factor was all-important : the opening date of the World Fair had to be met.

In order to avoid certain misunderstandings, it should be recalled, I believe, that the construction of the Atomium is the work of a private concern, encouraged by the public authorities, but with full responsability resting on its promotors, i. e. the three Belgian Metal Industry Groups.

Their aim has been essentially to give the World Fair 1958, and the town of Brussels, an imposing and original structure that would serve as an illustration of the new techniques which are to condition the lives of the men of to-morrow.

I am particularly glad to have the possibility of paying tribute to the exceptional efforts which were made, with enthusiasm and the firm will to succeed, by all the collaborators of the three promoting groups, by the many firms which took part in the design and construction, by the engineers, the technicians, and by these remarkable teams of workmen, amongst which I must single out the erection teams ; they were faced with a difficult and often dangerous task.

I also want to thank the Minister for Economic Affairs and the High Commissioner of the Fair, together with his collaborators, who have in all circumstances given us a helping hand.

I finally wish to thank the Lord Mayor and Aldermen of Brussels who agreed to let the Atomium survive after the Exhibition, as a reminder, at the Heysel, of this grand event.

BOARD OF DIRECTORS OF THE ATOMIUM ASSOCIATION

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Président de Fabrimétal.

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Directeur :
M. Franz Hébrant,
Directeur de la Commission pour l'Etude de la Construction métallique.

Description and realisation of the Atomium

by its creator Mr. A. WATERKEYN
Chartered Engineer
Managing Director of the "Atomium" Association

It was in January 1955 that the Atomium project, which I had presented to the Belgian Metal Industries, entered the design phase in order to be erected at the 1958 Exhibition.

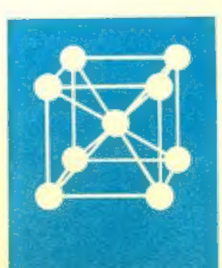
The Atomium is a symbol of the atom concept, because it represents a crystal mollecule of metal, actually of the centered cubic system.

In this crystal system, the atoms are placed on the vertexes of a cube, and one atom occupies its center.

The elementary centered cubic system is composed of 9 atoms placed as shown in Fig. 1.

In crystal chemistry, the structure of crystals is commonly represented by spheres the centers of which materialise the mean position of the atom in the

Fig. nr 1.



crystal network; the binding forces which exist between the atoms are materialised by links interconnecting the spheres. These binding forces are the essential cause of the chemical properties and the mechanical resistance of the different elements, and particularly metals; it is thus perfectly logical to clearly mark their existence in any representation of crystals.

Starting from the basic idea of a crystal of metal at atomic scale as a symbol — which was suitable for both the metal industry, promoter of the project, and the Exhibition, I thought of considerably increasing (in fact, 165 billion times) the distances which separate the centers of the atom in the cristalline system, so as turn them into a construction in which the spheres representing the atoms would be of sufficient size to house the exhibits relative to this branch of science.

The public had to be able to move from one sphere to the other without effort, which meant placing escalators in the inclined tubes representing the binding forces; this condition led to the choice of diameter for the interconnecting tubes. The dimensions which I initially proposed for the actual spheres (a diameter of about 65.6 ft) were not directly scaled up from the actual steel atom dimensions because, if this had been the case, they would have been larger. The diameter finally chosen (59 ft) was a compromise between a hall of suitable size and practicability of construction.

The particular position chosen for the cube, i. e. resting on one sphere with a vertical diagonal, was essentially dictated by esthetical reasons. Such a

position made it of course necessary to insure the stability of the structure by three pylons called "bipods" ; they have two principal functions :

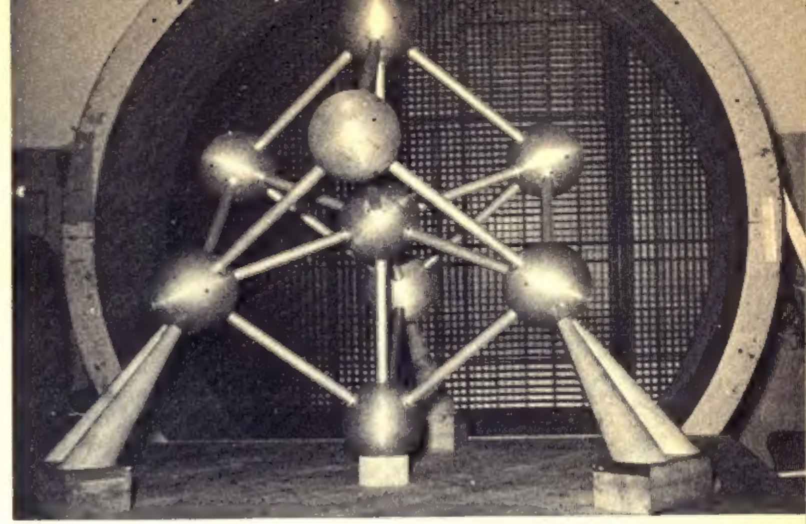
a) Support the three lower spheres of the Atomium ;

b) Allow the installation of the stairs, which are essential to evacuate the public entering the Atomium by the base sphere.

The basic structure of the construction had to be of steel and the skin of the 9 spheres in aluminium. The spheres that could be visited had to have at least two floors, the levels of which had to coincide with the linking tubes penetration points.

The design studies.

The first problem that had to be solved was to know what force the wind would apply on the Atomium and its foundations. If the drag of an isolated sphere is well known and can be computed, given the diameter of the sphere only, it is not so for a group of nine spheres which are relatively near each other and connected by tubes of an appreciable diameter. Tests thus had to be made on reduced-scale models ; these tests were made in the wind tunnel of the Ministry of Transport under the leadership of a consulting engineer, Mr. A. Joukoff. They lasted several months, but we quickly had the total drag of the wind on the nine spheres, acting in different directions, and we were surprised at the relatively low value found. The spheres partially protected each other from the effects of the wind.



These tests took place from June to September 1955. In October of the same year, the preliminary design work on the interior disposition of the spheres was being undertaken by the architects Messrs. A. & J. Polak. The difficult problem of a fast elevator which was to bring the visitors to the uppermost sphere at a speed of 16,4 ft/sec. was well on the way to being solved by an important European firm.

An initial preliminary design of the steel structure of the Atomium was proposed by "La Construction Soudée Co. Ltd", Consulting Engineers, which were entrusted with the calculations.

The use to which the spheres were to be put, and the circulation of the visitors, were of course serious problems. In the beginning, the idea of maximum utilization of the nine spheres of the Atomium seemed to prevail, but after due consideration and taking into account the large number of visitors which the Atomium could theoretically contain, it was decided

to open six spheres only to the public: the base sphere, the three lower spheres (the ones which are supported by the bipods), the central sphere and the top sphere.

Dimensions of the Atomium.

The Atomium is 334.6 ft high; the spheres have a diameter of 59.0 ft.

The distance between the spheres, measured on the sides of the cube, is 95.1 ft; the diameter of the tubes is 9.8 ft. The diagonal tubes are 75.4 ft long and of 10.8 ft diameter.

The diameter of the pavilion on which the base sphere appears to rest is 85.3 ft.

The base sphere rests on the foundation via the central tube of 10.8 ft diameter and twelve columns of 16.4 ft height.

The circular cut-out in the lower part of the sphere has a diameter of 32.8 ft.

The bipods are 295.3 ft apart and their articulations are 164 ft away from the central mast.

The escalators installed inside the tubes of the Atomium are amongst the longest in Europe. The largest is 114.8 ft long. They can take 3,000 persons per hour.

The elevator speed—the highest in Europe—is 16.4 ft/sec. It takes visitors up to the top sphere in 23 seconds and its capacity is 22 persons.

A floor has an area of 2,583 sq. ft and the height between floors is approximately 14.8 ft. The restau-

rant in the top sphere can sit 140 persons and the viewpoint situated below can contain 250 persons.

The stairs inside the bipods—which are 115 ft high—have approximately 200 steps.

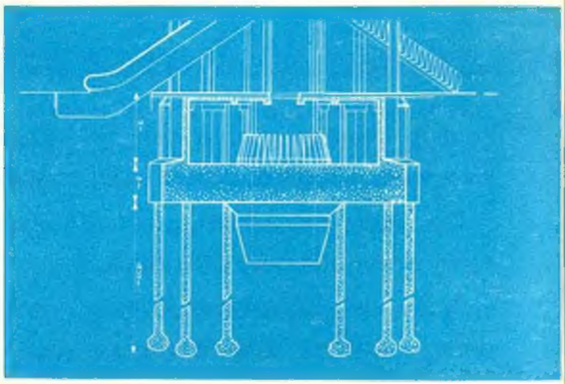
A scientific exhibition of the peaceful uses of atomic energy will be held in the reception hall, the base sphere and two lower spheres, as well as on the first floor of the central sphere.

A restaurant and a viewpoint are to be situated in the top sphere, the equator of which is 302 ft above ground. Another viewpoint is planned in the third lower sphere.

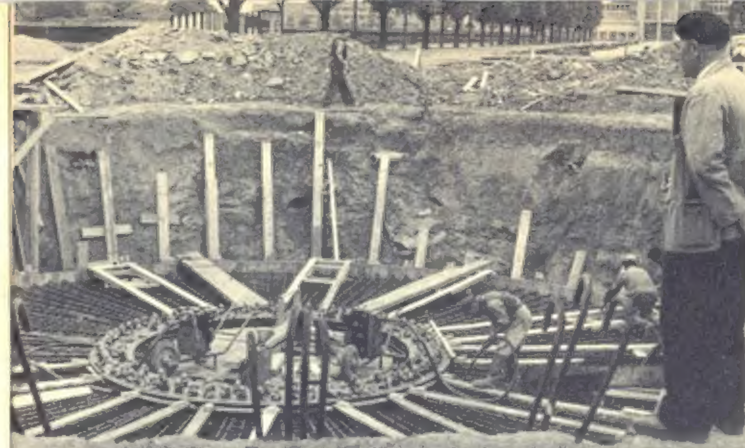
The foundations.

Work was started in March 1956, after soundings had been made of the ground on which the Atomium was to be erected. These tests showed the necessity of driving enlarged base concrete piles moulded into

the ground to a depth of 57 ft. Hammering started in April and lasted till June. One hundred and twenty three piles were driven, in four distinct groups. A group of 59 piles in four concentric circles for the central foundation supporting the central mast, which is really the backbone of the whole Atomium ; this 10.8 ft diameter column, in fact, takes considerable stresses. Three other groups of 24 piles each carry



the foundations of the three bipods ; these piles were driven inclined 17°, which is the angle of the bipods to the vertical. After the pile driving operation, the thick reinforced concrete sleepers were made ; they join together the heads of the piles and receive the attachment points of the metallic structure. For the central foundation, the sleeper was a circular slab 39 ft in diameter and 6.5 ft thick, with a 10 ft diameter hole in the center to insure passage of the lift and its end-of-travel machinery. The weight of concrete of the central foundation is roughly 500 tons.

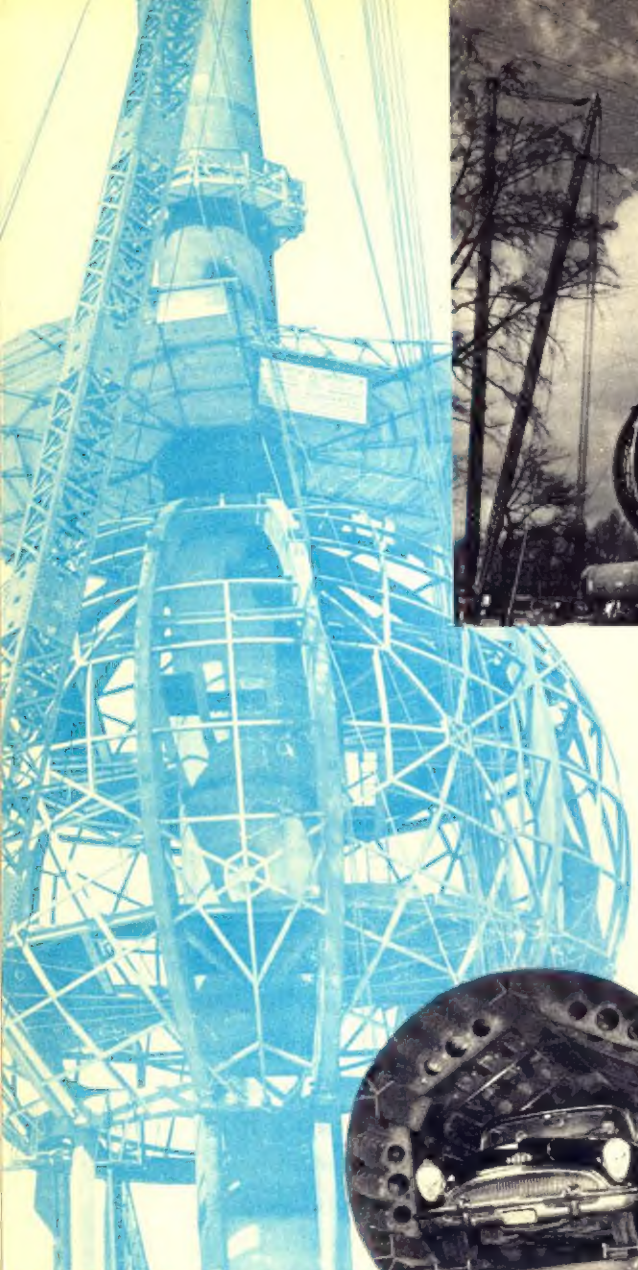


The metal framework.

A. THE TUBES.

The Atomium's central tube, 10.8 ft in diameter, is 348 ft long and made up of cylindrical steel ferrules of 12 mm thickness up to a height of 197 ft, and of 6 mm thickness the rest of the way to the top. The steel plates, which are arched and welded, are reinforced internally, first by 12 strong angle bars 7.87 in. by 7.87 in. in high grade steel forming a hexagon at the vertex of which they are joined by twos, secondly by longitudinal and transversal stiffeners which prevent any buckling of the outer ferrule. This central column is highly resistant to compression and flexion stresses. The 348 ft high mast is made up of several sections the lengths of which vary from 10 to 39 ft. The circular space within is entirely occupied by the lift, its guide-rails and counterweights. The base of the mast is 10 ft below ground-level.

The central mast weighs approximately 1.81 ton per yard in the first half, and 1.35 ton per yard from the middle of the central sphere to the top.



The other linking tubes between spheres differ structurally from the central mast by one point : the strong longitudinal angle bars are suppressed, the ferrule is only 6 mm thick and the weight of those tubes is only 0.9 ton per yard. All the tubes linking the outer spheres are 9.84 ft diameter, while the diagonal ones, i. e. those linking the outer spheres with the central one, are 10.82 ft in diameter. The reason for this difference is that it has been endeavoured to reduce the tube diameters as much as possible for esthetical reasons. When these were steeply inclined, as it is the case for the outer tubes, their vertical section, with a 9.84 ft diameter, is sufficient for passage, even in the case of the tube containing an escalator.

For the diagonal links, the slope of the tubes—which is only 19° to the horizontal—necessitates a 10 % increase of diameter, otherwise the free space available between the escalator steps and the tube roofing could have been insufficient.

B. THE SPHERES.

The spheres must of necessity have a particularly resistant structure at the tube junctions and it is logical to have a main framework made up of arches supported—in the case of the three spheres on the vertical axis—on the central mast. Each sphere has 12 arches. Six highly resistant arches are necessary, in the case of the base sphere, to take the thrust of three tubes ; the six others take up the stresses from the floors and from the secondary framework which trusses the 12 arches and supports the skin. In the

ground and each put in place as a single piece, lifted by two lifting arms at their centre of gravity.

C. THE BIPODS.

Each of the three bipods, weighing over 100 tons, is made up of two enormous triangular box spars, entirely welded, 118 ft long and each weighing 39 tons. The two spars are assembled on the site by bolted joints. A very rigid crossbar links the two main spars at the level of the large landing, which is about 33 ft above ground. The trusses inclined as the stairs are bolted to the two square-section braces which support the landings fitted inside the main spars.

The exterior covering of the spheres.

There were three conditions to the choice of the solution :

1. The possibility of fixing the skin elements on the spheres at great height.

2. The covering had to be rain-proof.

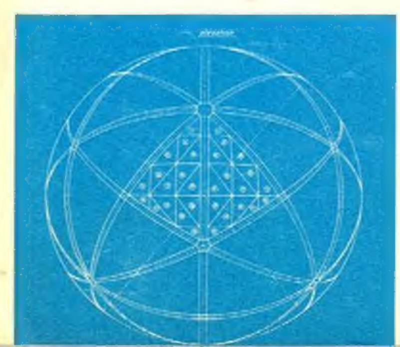
3. The exterior aspect had to conform with what the Atomium was supposed to represent.

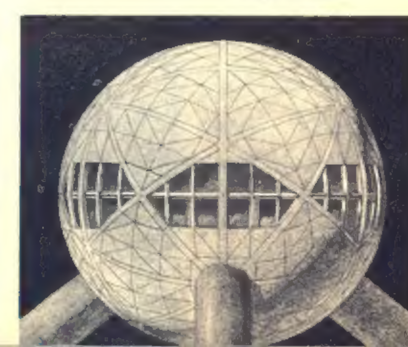
There were very few similar constructions from which experience could be drawn for the covering of the Atomium. The construction to which it could best be compared was the Dome of Discovery at the London Exhibition in 1951.

The experience provided by the English engineers gave us two starting points for the choice of our solution : riveting the sheets did not make the skin sufficiently rainproof, and the connecting rod system had to be used, the more so as the framework of the Atomium was of steel, which meant taking into account the different coefficients of expansion of the aluminium skin and the framework of the sphere.

Spherical triangles, the three sides of which are great circles of the sphere, have the advantage of providing uniform radiuses for all the elements.

Fig. nr 2.





So as to arrive at an esthetical solution which would be as close as possible to the symbol of the Atomium, I tried to divide the surface of the sphere by great circles into the greatest possible number of equal spherical triangles. Using the junction of the tube center-lines with the sphere as compulsory meeting points, I was led to trace a network of 48 equal or symetric spherical triangles formed by the intersections of nine great circles disposed as shown in Fig. 2. These 48 great spherical triangles are the basis of the system adopted. These had to be further subdivided into spherical triangles to have the necessary panels of sheeting for the nine spheres, bearing in mind of course the cut-outs necessary for the tubes and the penetration points of the bipods and their stairs.

An added point was that it was to be possible at night, to light up the Atomium by circulating luminous spots along the 9 great circles of each sphere. With these points for a start, the Enghien St. Eloi Co. Ltd built a system of aluminium panels out of 12/10 mm thick sheet, the edges of which are mounted on a special welded aluminium frame.

Each of the 48 great triangles is made up of 15 of these small panels which are themselves spherical triangles. The 9 great circles which separate the 48 great triangles are 16-inch wide ribbon sheets, in rectangular sections.

All these panels are bolted together from inside and their intersection made rainproof by a plastic joint and a second one in rubber.

The junction points at the summit of the triangles are supported by circular plates which are attached to the secondary framework by means of a connecting rod made flexible by a sort of rubber Cardan.

The choice of disposition of the 15 secondary triangles was conditioned by the fact that, in certain spheres of the Atomium, large plexiglass windows had to be put in place of the aluminium panels.

The aluminium of the spheres is a very special metal. It is an alloy called "Peraluman 15" overlaid, by rolling, with a thin sheet of aluminium called "reflectal", which can be nearly specularly polished by a special process.

The exterior night-lighting is made by placing circular light-points at regular intervals (about 5 ft) along the nine great circles of each sphere. By means of rotary switchgear, the lamps come on and off successively ; this gives the impression of luminous spots turning around the spheres at a certain speed. These luminous spots meet at the intersection of the great circles and thus gives the spectator an impression of pulsating light at different points of the sphere. The idea of this lighting is to represent the rotation of the electrons around each atom of the iron crystal.

Stability of the Atomium.

It is a result of the conception of its supporting points. The three bipods, articulated on their foundations, and the six tubes that connect them to the base sphere and to the central sphere—these are each penetrated by the central column which is itself anchored onto the central foundation—together make an absolutely stable base.

It is on this lower ensemble, completed by the framework of the three lower spheres, that the system made up of the three middle spheres and of the top sphere is supported. So as to avoid the difficulties of stress calculations in hyperstatic constructions, two liaisons were abolished by enabling two of the tubes to slide at one extremity on their support. The tubes concerned are a diagonal tube linking the first lower sphere with the central one, and the prolongation of this diagonal towards the middle sphere opposite. In simpler terms for the uninitiated : an equally strong Atomium could be built by simply suppressing two of the tubes that make up a diagonal.

In this special construction, it is only normal that exceptional precautions were taken to check the calculations and to test the welded assemblies. Tests were carried out on the structure itself by applying known loads at selected points and measuring the actual stresses in the steel at certain points. These tests confirmed the exactness of the calculations and the validity of the basic hypothesis.

The measured stresses were always, in fact, in close agreement with the pre-computed stresses, to a very

acceptable tolerance. The strain-gauges used for these stress measurements will stay in place and it will thus be possible to continue these when the work is finished and the Atomium in normal use.

Specialised scientific bodies have found these tests most interesting to the future progress of metal construction generally and have brought their help for these technical investigations.

Erection.

The erection of the Atomium was very successfully accomplished by the "Ateliers de construction de

Jambes-Namur", who used, for this difficult task, teams of highly qualified riggers and equipment on a large scale.

The first section of the central vertical mast was put in place beginning of 1957. It was a tube 59 ft long, 10.8 ft in diameter and weighed 39 tons. (The structure of this tube was gone into previously). The ring where the twelve arches of the base sphere are articulated, is welded on the top part.

The second operation carried out consisted in placing the twelve rectangular section columns supporting the large 33 ft diameter crown, which carries the lower ends of the 12 box spars making up the main framework of the base sphere. The beams for the two floors, and the secondary framework linking the large arches, were laid in March 1957 ; the skinning with polished aluminium panels followed immediately

—as it was necessary to test the new spherical triangles system—and the base sphere was finished in early May. In the meantime, erection of the central mast was carried on with an inclinable spar 59 ft high which the riggers elevated and fixed on the central mast as it grew higher. The central mast, which serves as the lift cage, was thus built up to a height of 335 ft, stabilised by wire struts ; it served as a main erecting mast after the three bipods and the framework of the three lower spheres had been put in place.

The bipods were raised onto their two spherical knee-pans by suspending them above their centre of gravity between two rigging booms 130 ft high. The bipod was provisionally steadied by an inclined mast while the framework of the lower sphere and the 95 ft tube connecting it to the base sphere were being put in place.

The first bipod was set up on 15th June ; the third on 25 September 1957. The central sphere was erected in October.

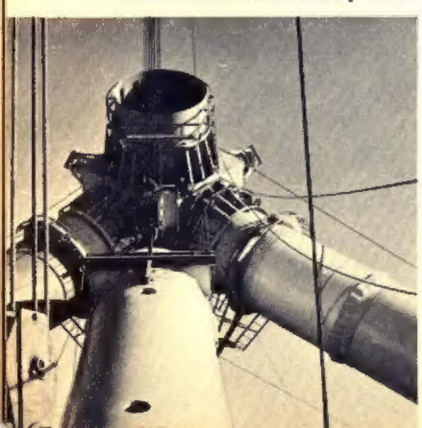
In October, November and December 1957, the framework of the three lower spheres was set up with the help of hoisting booms installed on the lower floor level of the sphere. The framework of the top sphere was assembled during December 1957 and January 1958. For this particular assembly operation, the riggers had replaced the arm that surmounted the central tube by a pyramid and a 49 ft spar boom. This rigging sét, which was heavily trussed and with a base 340 ft above ground, stayed in place till the end of the erection of the Atomium, i. e. end March 1958.

After that, a large 148 ft long crane boom was

installed on a platform immediately above the central sphere. It enabled the assembly of the three higher spheres and the 12 tubes of approximately 30 tons each which connect them with the other spheres.

The assembly of the three middle spheres presented quite a problem in view of their height (246 ft at the equator of the sphere) and their distance from the central mast.

It was solved by erecting three temporary 213 ft high masts, which supported the cube that formed the centre of each middle sphere. The cube, with 13 ft sides, is made with welded plates. It is disposed as the Atomium itself, i. e. with a vertical diagonal. Four



liaison tubes connect up to this cube, which is hollow and allows passage for the stairs coming from the top sphere.

The middle spheres are also made up of 12 arches which are attached top and bottom to two small towers fixed onto the upper and lower central cube of the sphere.

Assembly of the middle spheres began in January 1958, to end on 25th March by the simultaneous removal of the three temporary 213 ft supporting masts.

The erection of Atomium went through some extre-

mely spectacular phases and the "Ateliers de Construction de Jambes-Namur" can be whole-heartedly thanked for the wonderful job done, whether by the design office, which conceived the principles and lifting equipment, or the teams of riggers, which really

surpassed themselves as far as efficiency and will to solve all difficulties were concerned.

Windows and ventilation.

An important feature contributing to the attraction of the Atomium was the question of the windows. The problem was complicated, as the greatest possible window area was desired without modifying the exterior skinning whilst keeping to a perfectly spherical shape.

It was in fact the window problem that led to the choice of the secondary triangulation subdividing each of the 48 great spherical triangles constituting the covering of the sphere. The problem was solved in that where windows were wanted, the aluminium panels were replaced by frames in which plexiglass sheets having the same spherical radius were fixed.

Three spheres are fitted with this system of windows which are on both sides of the sphere's equator : the top sphere with its restaurant and the two lower spheres where the circuit for the visitors to the technical exhibition ends. The other spheres are lit by a few elliptical port holes which give emergency lighting, the main lighting being artificial.

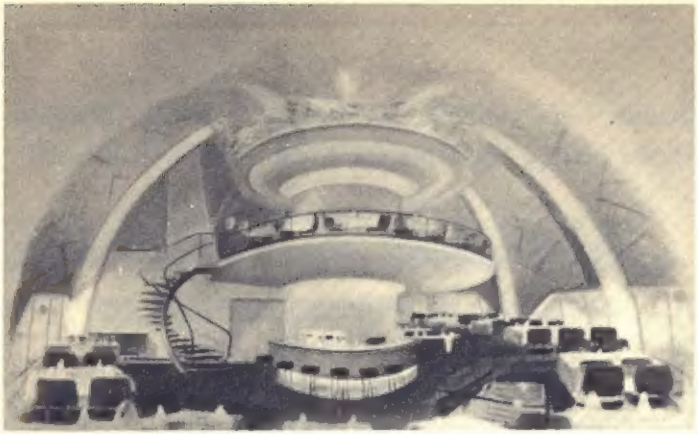
It was unadvisable, in fact, to provide too many view points in the lower spheres, as this would have held up the flow of the visitors to the part containing the technical exhibits.

The spheres being closed, it was necessary to air-condition and ventilate them.

Two different systems have been adopted for the Atomium :

1. For the reception pavilion and the base sphere, the air conditioning is made by one machine situated outside the Atomium, the cold or warm air—according to necessity—being led in at floor-level by metal sheaths. Use has been made of the new system called "heat pump" which uses refrigeration machinery to send warm air by inverting the cycle.

2. For the other spheres, an independent conditioning system is used. Each sphere has six cupboards containing the refrigeration, heating and ventilating systems.

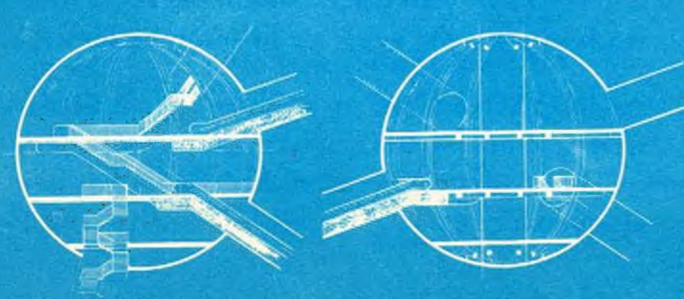


Circulation and occupation of the spheres.

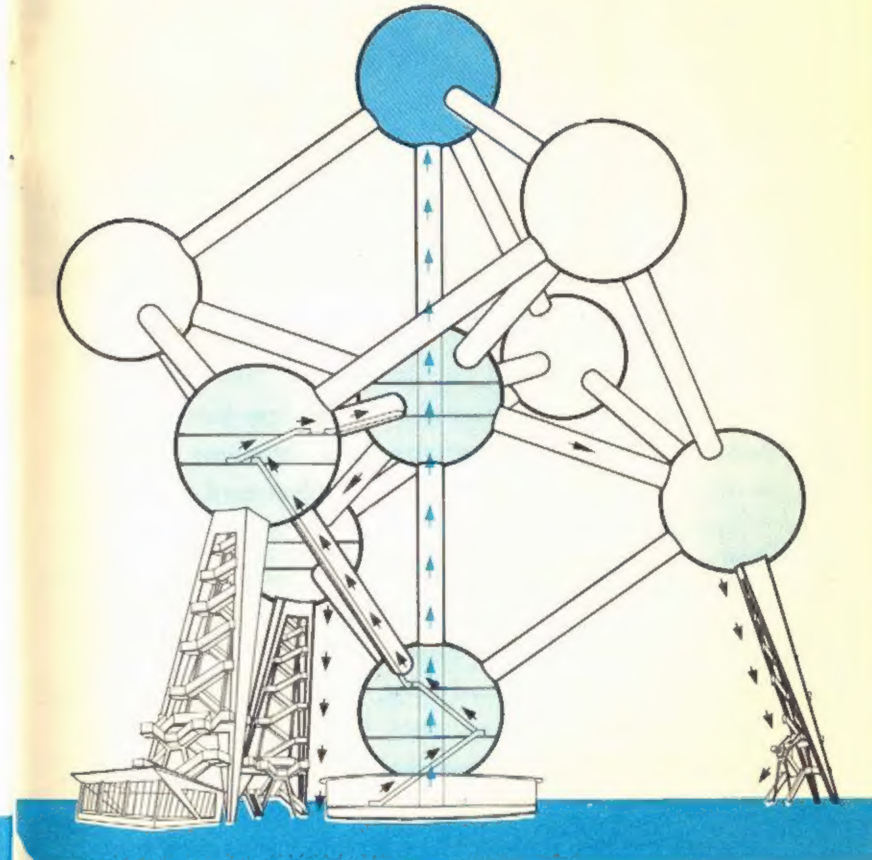
Accommodating the maximum flow of visitors was the key that led to the choice of the most suitable path to be followed for the visit, and to the number of escalators and stairs.

The top sphere has, in addition to the restaurant in the upper half, a circular viewpoint where about 250 persons can easily look through the six large plexiglass windows. The comfortable restaurant can accommodate 140 persons. Access to the top sphere is by a fast lift taking 22 persons up at 16.4 ft/s.

The descent is solely by the lift, but there are two



stairs which, leading from the top sphere via the tubes to the middle spheres, join up with two lower spheres and thence to the stairs of the corresponding bipods. The number of visitors that can reach the top sphere



depends only on the lift capacity and the average time spent by the visitors in that sphere. About 400 persons an hour can be taken up to the top sphere.

For the visit of the other spheres, several circuits were possible in principle but there were three conditions that led to the optimum choice.

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Civ. Eng. U. I. Lv.
Managing Director
Designer
of the Atomium

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Civ. Eng. A. I. Lg.
Manager

A. BECKERS
Civ. Eng. A. I. Br.
Cons. Eng.

E. VERHOEVEN
Comm. Eng. U. Lv.
Deputy Manager

A. JOUKOFF
Civ. Eng. A. I. Br.
Cons. Eng.

E. GREINER
Civ. Eng. A. I. Lg.
Managing Director

F. PIETTE
Civ. Eng. I. G. Lg.
Seco Office

F. COOLS
Chief fitter
Ateliers de
Jambes-Namur

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Architect D. P. L. G.

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Civ. Eng. A. I. Lg.
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R. VANDENHAUTE
Civ. Eng.
Man. Fitting Dept.
Ateliers de Jambes-Namur

F. DEMOL
Civ. Eng. A. I. Lg.
Deputy Manager

Individuals and firms that have collaborated to the making of the Atomium:

Consultant engineers :

S. A. La Construction Soudée (MM. Beckers et Joukoff) à Haren, assistée du Bureau d'Etudes V. Daniel, Bruxelles.

Architects :

MM. A. & J. Polak, Bruxelles.

Calculation control and work control :

Bureau Seco à Bruxelles.

Erecting :

Le montage complet a été réalisé par les Ateliers de Construction de Jambes-Namur à Jambes.

Framework manufacture :

S. A. La Brugeoise & Nivelles à St-Michel-lez-Bruges (Bipodes, tubes de liaison, 3 sphères I).

Anc. Etabl. Métallurgiques Nobels-Peelman à St-Nicolas-Waes (Mât central - sphère C - sphère S).

Ateliers de Construction de Jambes-Namur à Jambes (3 sphères M).

La Construction Soudée à Haren (sphère B, pavillon d'accueil).

Ateliers Lefèvre Frères à Ransart (sphère B).

S. A. Fabricom à Vilvorde (sphère B).

S. A. Cockerill-Ougrée à Seraing (Pièces d'appui des bipodes).

Concrete piles :

Socofonda à Bruxelles.

Foundation and reception pavilion :

Entreprises Ed. François & Fils à Bruxelles.

Steel suppliers :

S. A. Cockerill-Ougrée, Seraing.
Columeta (ARBED).
Les Forges de et à Clabecq.
Sté Métallurgique Hainaut-Sambre à Couillet.
Les Forges de la Providence à Marchienne-au-Pont.

Aluminium sheeting manufacturers :

Sté Métallurgique d'Enghien-St-Eloi, à Enghien.

Polishing and anodising of the sheeting :

Constructions électriques Schréder à Ans-lez-Liège.